



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
11.02.2015 Bulletin 2015/07

(51) Int Cl.:
B60C 7/10 (2006.01) B60C 17/04 (2006.01)

(21) Application number: **13878533.2**

(86) International application number:
PCT/KR2013/007932

(22) Date of filing: **03.09.2013**

(87) International publication number:
WO 2014/196693 (11.12.2014 Gazette 2014/50)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(30) Priority: **05.06.2013 KR 20130064648**

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(54) **PUNCTURE-PROOF AND BULLETPROOF TIRE**

(57) The present invention relates to a no-puncture bullet-proof tire, which can prevent a puncture, a tear or a rupture of a tire by a nail, a reinforcing bar piece, a steel plate piece, a bullet, or other various kinds of fragments, and can enable a vehicle to safely run at a high speed

of about 100 kilometers or more per hour under a high temperature environment of about 60 °C or more and a low temperature environment of about -60 °C or less, by filling the inside of the tire with a mixture of silicon rubber and spherical EVA foam without an air pressure.

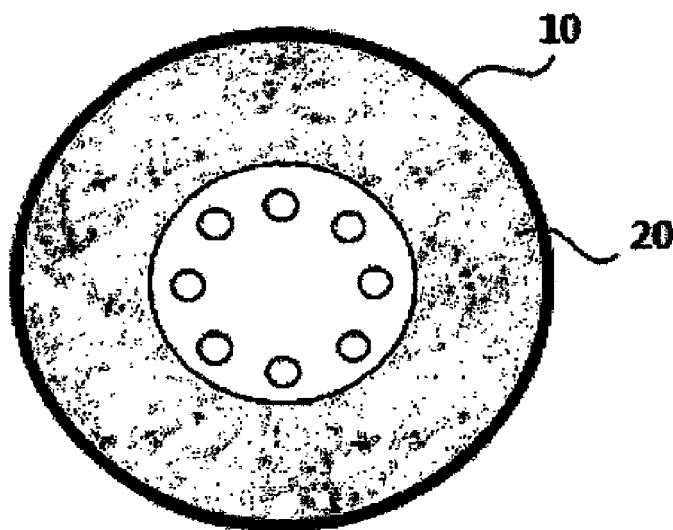


Fig.4

Description

Technical Field

[0001] The present invention disclosed herein relates to a no-puncture bullet-proof tire, and more particularly, to a no-puncture bullet-proof tire which can prevent a puncture, a tear or a rupture of a tire by a nail, a reinforcing bar piece, a steel plate piece, a bullet, or other various kinds of fragments, and can enable a vehicle to safely run at a high speed of about 100 kilometers or more per hour under a high temperature environment of about 60 °C or more and a low temperature environment of about -60 °C or less, by filling the inside of the tire with a mixture of silicon rubber and spherical Ethylene Vinyl Acetate (EVA) foam without an air pressure.

Background Art

[0002] Generally, an axle of a vehicle running on streets is equipped with wheels rotated by a driving force generated by and transmitted from an engine when the engine operates. The wheels are equipped with tires that support the weight of a vehicle, alleviate an impact from a road, and transmit a driving force from an engine, a braking force, and a steering force to a road surface, maintaining the run of a vehicle. Such tires are classified into tube-embedded tires with a tube to keep air pressure and tubeless tires without a tube embedded therein.

[0003] Meanwhile, when a tire is punctured or is torn while a vehicle runs, a vehicle may lose balance and steering ability, and then may rear-end or may roll over into a large accident. In other words, when a puncture occurs, a vehicle may suddenly tilt toward the side of the punctured wheel and may undergo a standing wave phenomenon that causes the shaking of a rear part of the tire like a wave and reduces ride comfort and increases a frictional heat, causing the rupture of the tire. This may lead to additional secondary, tertiary and even higher order of accidents, interrupting safe driving.

[0004] Accordingly, in order to prevent the standing wave phenomenon, a tire injected with silica that is a liquid adhesive is once developed. However, even though the tire can avoid punctures that may be caused by a nail or fragment having a diameter of about 7 mm or less, the tire was not free from punctures caused by a larger nail or reinforcing bar having a diameter is about 7 mm or more. Also, since the technique is only applied to the tire-tread, there is a limitation in that the sidewall of a tire still risks a danger of puncture. Moreover, when an object that is not cylindrical like a nail but is planar like an iron plate or a knife is stuck in the tire, silica leaks and thus the tire has to be replaced. Meanwhile, an airless tire having a beehive-like hexagonal shape is once developed, but has a limitation in practicality due to excessive noise and vibration during the high speed driving of a vehicle.

[0005] Accordingly, constant research and develop-

ment efforts are being made for solving the limitations as described above. There are Korean Patent Application Publication No. 10-2002-0031991 entitled "tire" and Korean Patent Application Publication No 10-2004-039067 entitled "safe tire wheel" as related prior arts.

[0006] Specifically, Korean Patent Application Publication No. 10-2002-0031991 entitled "tire", as shown in FIGS. 1 and 2, discloses a tire disposed at both ends of an axle that is installed under a vehicle body and transmits a driving force of a vehicle. The tire includes a rim 1 installed in the center of the tire, an elastic part 2 formed of silicon on the outer circumference of the rim 1 and having its own elasticity, and a tread part 3 formed of crude rubber on the outer circumference of the elastic part 2 to exert a driving force and a braking force, and a plurality of protruding parts 4 formed on the outer circumference of the elastic part 2 coupled to the tread part having a concave part corresponding to the plurality of protruding parts 4. Also, the elastic part 2 is molded to include air bubbles 5 that independently contain air, respectively, and allows the tread part to be coupled to the outer circumference thereof.

[0007] However, in the case of Korean Patent Application Publication No. 10-2002-0031991 entitled "tire", there is a limitation in that when a nail, a reinforcing bar piece or a piece of steel plate is stuck in the tire, air leaks out of the air bubbles in the corresponding part. Thus, when the tread part of the tire contacts the ground, an unevenness occurs due to a weak pressure of the air bubbles from which air leaks. Accordingly, a vehicle shakes and bounces such that a vehicle cannot run at a high speed. Also, the tire needs to be replaced whenever a nail, a piece of reinforcing bar, or a piece of steel plate is stuck as described above.

[0008] Korean Patent Application Publication No 10-2004-039067 entitled "safe tire wheel", as shown in FIG. 3, discloses a wheel and tire 1 filled with rubber materials such as synthetic resin 2 and silicon, or other materials 3. Here, a material with smaller shock absorption is disposed at the side of the wheel 9, and materials with larger shock absorption such as synthetic resin 2, silicon, other material 3 and rubber material are sequentially and separately disposed thereafter.

[0009] However, in case of Korean Patent Application Publication No 10-2004-039067 entitled "safe tire wheel", when a vehicle equipped with the tire continues to run on a highway at about 100 kilometers or more per hour for a long time, the tire heats up to more than about 80 °C to 90 °C and loses the function as a tire due to softening of the synthetic resin or general materials filled in the tire. More specifically, since the tire pressure drops down and the tire elasticity drops down as well, the tire cannot endure the vehicle weight and is compressed, and a vehicle cannot run at a high speed. Shaking and bouncing of a vehicle occurs when a vehicle runs in cold winter of about -20 °C to about -40 °C due to the loss of elasticity caused by the hardening of synthetic resin, rubber material and general material. Additionally, since a

material with smaller shock absorption is disposed at the wheel side and other materials with larger shock absorption such as synthetic resin, silicon, other materials, and rubber materials are separately disposed thereafter, the materials are softened at a high temperature of 80 °C or more and are hardened at low temperature of about -20 °C to -40 °C. Accordingly, a vehicle cannot drive at a high speed.

Disclosure of the Invention

Technical Problem

[0010] Accordingly, the present disclosure provides a no-puncture bullet-proof tire, which can prevent a puncture, a tear or a rupture of a tire by a nail, a reinforcing bar piece, a steel plate piece, a bullet, or other various kinds of fragments, and can enable a vehicle to safely run at a high speed of about 100 kilometers or more per hour under a high temperature environment of about 60 °C or more and a low temperature environment of about -60 °C or less, by filling the inside of the tire with a mixture of silicon rubber and spherical Ethylene Vinyl Acetate (EVA) foam without an air pressure.

Technical Solution

[0011] The invention provides a no-puncture bullet-proof tire including silicon rubber and spherical EVA foam filled in the tire.

[0012] Here, the silicon rubber and spherical EVA foam are mixed and filled at a mixture ratio of about 25 to about 35 parts by weight of spherical EVA foam with respect to about 100 parts by weight of silicon rubber, and

[0013] The spherical EVA foam has a diameter of about 3 mm to about 6 mm.

Advantageous Effects

[0014] Since a vehicle tire puncture or rupture while running may cause a user not to perform his/her works or a vehicle tire explosion while running downhill may even kill or seriously injure passengers, thus causing immense trouble and damage to a user, a no-puncture bullet-proof tire according to an embodiment of the present invention may have the effect of enabling a driver to safely use a vehicle without worries by preventing puncture or rupture of the tire.

[0015] More specifically, filled with silicon rubber and EVA, the tire can exhibit about 100 % the same elasticity as tires using compressed air, and has a variety of better effects than typical tires using compressed air.

[0016] Vehicles equipped with the tire can safely run at a high speed at about 100 kilometers or more per hour in a tropical region or desert of high temperature environments where the temperature is about 60 °C or more and in low temperature environments where the temperature is about -60 °C or less. Also, a driver of a vehicle

suffers no trouble in driving a vehicle again even after long parking, and the tire is a literally all-weather tire that can be used without a puncture even for several years until the lifespan of the tire expires. Furthermore, when the lifespan of the tire expires, only silicon rubber inside the tire can be separated and permanently recycled.

[0017] Here, the term 'permanent recycle' means that even when the tire is out of use due to damages such as a tear or a rupture, silicon rubber inside the tire can be reused in a new tire as it is, and can exert the same performance for the same purpose even though there are any damages such as tear or rupture on silicon rubber.

[0018] Furthermore, due to the excellence of silicon rubber itself in elasticity, tensile strength, heat resistance, cold resistance, and weather resistance, a vehicle may have no trouble in running at a high speed on a highway, an unpaved road, or a wet road at about 100 kilometers or more per hour even though a large nail having a diameter of about 10 mm or more, a large reinforcing bar piece, or a large steel plate piece is stuck in the tread or sidewall of the tire. Of course, when high-speed running continues with a large nail, a large reinforcing bar piece or a large steel plate piece stuck in the tire, a slight vibration and/or a slight noise may occur due to the unbalance of wheels. In this case, when such foreign substances as a nail or a reinforcing bar piece are eliminated from the tire, a vehicle can still run at a high speed as usual.

[0019] In addition, a test result as a bullet-proof tire shows excellence in practicality and economy compared to any other bullet-proof tire. The bullet-proof tires that are being widely used are very expensive due to the complex use of a variety of state-of-art materials, and air is injected into the innermost side of tires to alleviate the hardness due to the use of multiple layers of the various kinds of state-of-art materials and thus maintain the elasticity of tires when a vehicle runs. Since internal air leaks slowly when the tire is punctured by a bullet, a vehicle equipped with the tires can further run for about 100 kilometers at about 80 kilometers or more per hour. However, the tire needs to be replaced later after the driving. On the other hand, in the embodiment of the present invention, it was verified in a test that a vehicle equipped with the tire could run for several hours at 120 kilometers or more per hour when the tire was hit by a bullet that is about 70 mm in length and about 14 mm in diameter (e.g., a general pistol bullet is commonly about 5 mm in diameter and about 30 mm in length and a general machine gun bullet is commonly about 10 mm in diameter and about 50 mm in length). Also, since the tire stuck with the bullet can be used for several months or years until the tire is replaced due to an abrasion of the tire, or can be continuously used after the bullet stuck in the tire is removed, the tire is more excellent in economy and practicality than other bullet-proof tires that are being currently used all over the world. Moreover, when the tire according to the embodiments of the present invention is applied to bicycles, motorcycles, farming vehicles and

heavy machinery vehicles as well as motor vehicles, its applicability can be infinite. Embarrassing situations, for example, that a user is stalled due to a tire puncture while driving a motorcycle on a mountain road will not occur forever.

[0020] Meanwhile, since silicon rubber, which is formed of silicon, is formed of silicon organic compound from sand in the beach and silica stone in the mountain abundant on earth, the price is low. Accordingly, when the tire is manufactured using the silicon rubber as a main base material, it will be very helpful to people in terms of economy. Also, the repair cost for puncture is not needed until the tire is worn out. Furthermore, when the lifespan of the tire expires, silicon rubber in the tire can be permanently recycled, thereby achieving economic efficiency and improving safety and convenience.

[0021] In the embodiments of the present invention, spherical EVA foam may be mixed with silicon rubber to be used in a tire. Since the specific gravity of silicon rubber is about 1.12 and the specific gravity of EVA is about 0.2, EVA is about five times lighter than silicon rubber, the fuel efficiency can be improved compared to when silicon rubber is used 100% to fill the tire. In addition, since EVA foam is highly expanded and thus serves as a sponge, elasticity of the tire, ride comfort, and shock absorptability can be improved when a vehicle runs on roads. Also, since EVA is cheaper ten times than the silicon rubber, due to mixing of EVA, the cost can be more saved than silicon rubber is used 100%, thereby becoming helpful in economy.

Description of Drawings

[0022]

FIGS. 1 and 2 are views illustrating a tire according to Korean Patent Application Publication No. 10-2002-0031991 entitled "tire",
FIG. 3 is a view illustrating a tire according to Korean Patent Application Publication No. 10-2004-039067 entitled "safe tire wheel",
FIG. 4 is a view illustrating no-puncture bullet-proof tire according to an embodiment of the present invention.

Best Mode

[0023] The present invention relates to a no-puncture bullet-proof tire to achieve the above effect, and throughout the drawings and the detailed description, descriptions or drawings of well-known functions and constructions which can be easily understood by those skilled in the art or which are not relevant to the features of the present invention are omitted for increased clarity and conciseness.

[0024] Hereinafter, the no-puncture bullet-proof tire will be described in detail with reference to the accompanying drawings.

[0025] FIG. 4 is a view illustrating a configuration of a no-puncture bullet-proof tire. The no-puncture bullet-proof tire may be filled with a mixture 20 of silicon rubber and spherical Ethylene Vinyl Acetate (EVA) foam.

5 **[0026]** Specifically, the no-puncture bullet-proof tire may be filled with a mixture of about 25 to about 35 parts by weight of spherical EVA foam with respect to 100 parts by weight of silicon rubber.

10 **[0027]** Silicon rubber used in the present invention may be a synthetic high molecular organic compound, the elasticity and properties of which are unchangeable even at about 250 °C and are unfrozen even at about -75 °C, and may be a non-toxic and eco-friendly material. Also, silicon rubber may be a known material having various excellent properties such as compression resistance, chemical resistance, low-temperature flexibility, weather resistance, heat resistance, cold resistance, flame resistance, oil resistance, and water resistance.

15 **[0028]** Spherical EVA foam used in the present invention may be a known material that is highly expanded, which is added to realize high fuel efficiency, soft elasticity, better ride comfort, increased impact absorption and cost saving, compared to when silicon rubber is 100 % filled.

20 **[0029]** Meanwhile, spherical EVA foam may have a diameter of about 3 mm to about 6 mm. For example, when the diameter of spherical EVA foam is less than 3 mm, spherical EVA foam may not be uniformly mixed with silicon rubber. Accordingly, spherical EVA foam needs to have a diameter of 3 mm or more. When the diameter of spherical EVA foam is more than 6 mm, puncture and bullet-proof functions may be reduced when stuck with a nail, a reinforcing bar piece or a steel plate piece. Accordingly, spherical EVA foam needs to have a diameter of 6 mm or less.

30 **[0030]** Additionally, when the content of spherical EVA foam is less than about 25 parts by weight, there may be no trouble with puncture and bullet-proof functions, but tire elasticity may decrease. Also, impact absorption becomes weak and ride comfort becomes bad upon high-speed driving. Since EVA is ten times cheaper and weighs five times lighter than silicon rubber as well, there may be no need to reduce the content of EVA into less than about 25 parts by weight in consideration of economic and functional characteristics such as fuel efficiency. Since the puncture and bullet-proof functions are reduced when the content of spherical EVA foam is more than about 35 parts by weight, the content of spherical EVA foam cannot exceed about 35 parts by weight

40 **[0031]** Due to the configuration described above, the tire according to the embodiment of the present invention can prevent puncture, tear or rupture of a tire by a nail, a reinforcing bar piece, a steel plate piece, a bullet or other kinds of fragments, and can enable a vehicle to safely drive at a high speed of about 100 kilometers or more per hour under a high temperature environment of about 60 °C or more and under low temperature environment of about -60 °C or less.

[0032] Meanwhile, it will be understood that the no-puncture bullet-proof tire according to the embodiment of the present invention can be variously modified and changed from the spirit and scope of the present invention as described in the following claims, and the various modifications and changes may also fall within the scope of the present invention. 5

Mode for Invention 10

[0033] One embodiment of the present invention relates to a no-puncture bullet-proof tire filled with a mixture of silicon rubber and spherical EVA foam without an air pressure.

[0034] The no-puncture bullet-proof tire is filled at a mixture ratio of about 25 to about 35 parts by weight of spherical EVA foam with respect to about 100 parts by weight of silicon rubber. 15

[0035] And, the spherical EVA foam has a diameter of about 3 mm to about 6 mm. 20

Industrial Applicability

[0036] With a mixture of silicon rubber and spherical EVA foam without an air pressure filled inside of the tire, a puncture, a tear or a rupture of a tire by a nail, a reinforcing bar piece, a steel plate piece, a bullet, or other various kinds of fragments can be prevented. Also, a vehicle can run at a high speed of about 100 kilometers or more per hour under a high temperature environment of about 60 °C or more and a low temperature environment of about -60 °C or less. 25 30

Claims 35

1. A no-puncture bullet-proof tire comprising silicon rubber and spherical Ethylene Vinyl Acetate (EVA) foam filled in the tire. 40
2. The no-puncture bullet-proof tire of claim 1, wherein the no-puncture bullet tire is filled at a mixture ratio of about 25 to about 35 parts by weight of spherical EVA foam with respect to about 100 parts by weight of silicon rubber. 45
3. The no-puncture bullet-proof tire of claim 1, wherein the spherical EVA foam has a diameter of about 3 mm to about 6 mm. 50

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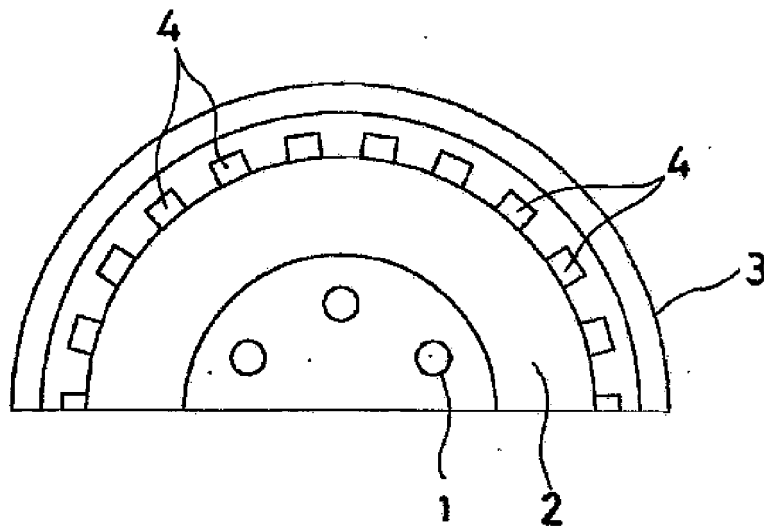


Fig 1

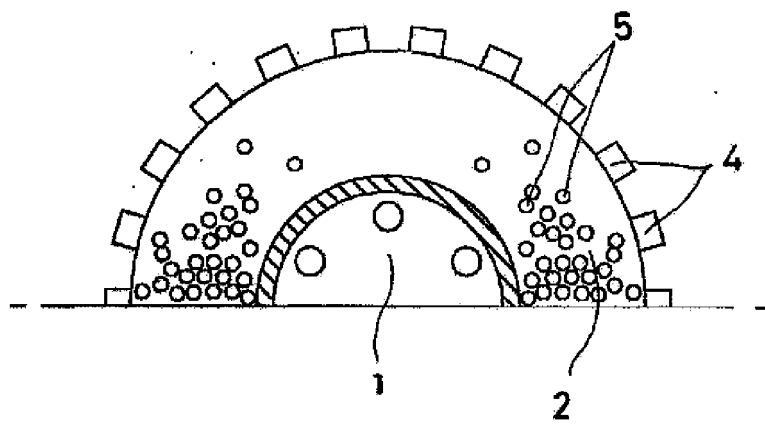


Fig.2

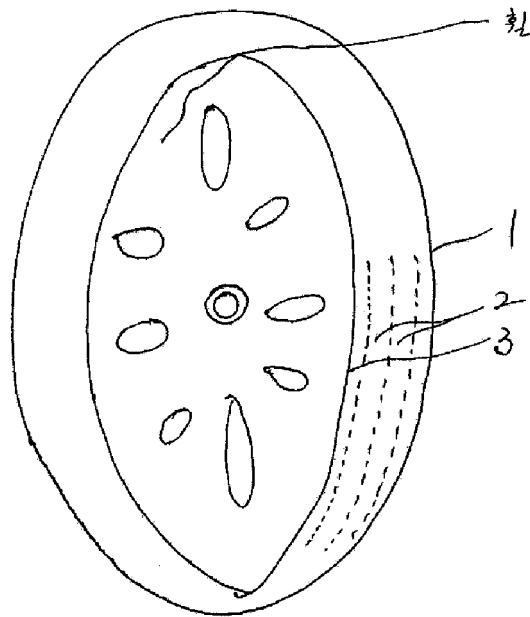


Fig. 3

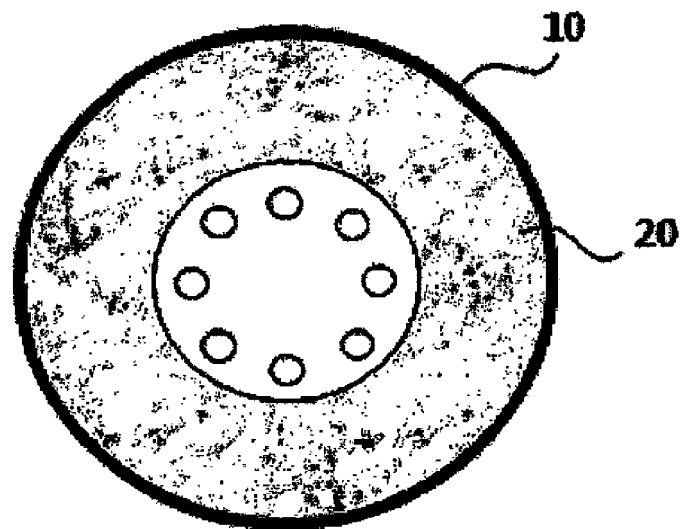


Fig.4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2013/007932

A. CLASSIFICATION OF SUBJECT MATTER

B60C 7/10(2006.01)i, B60C 17/04(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60C 7/10; B60C 17/06; B60C 7/00; B60C 17/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: tire, bulletproof, flat tire prediction

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 3138955 U9 (MAXWERH. IN) 26 December 2007 See figure 1, paragraphs [0009], [0014]	1-3
Y	KR 10-2004-0039067 A (SON, Young Suk) 10 May 2004 See figure 1, claim 1	1-3

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

05 MARCH 2014 (05.03.2014)

Date of mailing of the international search report

06 MARCH 2014 (06.03.2014)

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2013/007932

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Patent document cited in search report	Publication date	Patent family member	Publication date
JP 3138955 U9	26/12/2007	NONE	
KR 10-2004-0039067 A	10/05/2004	NONE	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 1020020031991 [0005] [0006] [0007] [0022]
- KR 102004039067 [0005] [0008] [0009]
- JP 102004039067 B [0022]